

Using Harvest Data to Monitor the Asian Carp Invasion in the Illinois and Mississippi Rivers: Applications and Policy Implications

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Information on commercial fish harvest can be used to analyze both the effect of the Asian carp invasion on the ecology of large rivers systems and the effect of policy options to control Asian carp. Using fifty years worth of harvest data from the Illinois Department of Natural Resources, we construct a model of fish harvest to test whether the abundance of Asian carp has impacted the harvest of native species. We address several statistical issues that arise from this particular data set. We also analyze associated information on fish prices to evaluate whether raising the price of commercially harvested Asian carp might be an effective control strategy and whether increasing the harvest of Asian carp will affect native fish species. We examine whether a positive price for Asian carp in some local markets has altered the harvest and abundance of Asian carp. Finally, we discuss the design and implementation of policies by which the commercial harvest of Asian carp might be increased, and whether such policies are effective control options.

Asian Carp Outreach: Past, Present and Future

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Both silver and bighead carp had escaped into our natural waterways by the early 1980s. As they became established and abundant, the need for public outreach emerged. In response to this need, agencies and organizations throughout the Mississippi River Basin conducted various outreach activities. These activities generally 1) informed citizens about aspects of Asian carp including their existence and general biology, 2) helped track movement of these fishes, 3) warned of their possible unintended transfer and release, and/or 4) suggested ways to catch and prepare them. We will report on these outreach efforts, and describe their goals and implementation. We also will identify outreach gaps and suggest ways in which they can be filled.

Asian Carps and the Canadian Live Food Fish Trade

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The live food fish industry is a major business in North America with a long history of providing consumers with live species for consumption. These markets are generally found in urban areas with Asian communities and are growing in number. Recent efforts to assess the risk of aquatic invasive fishes being introduced into the wild through the live food trade have revealed many knowledge gaps and previously unknown records. Although work is ongoing, Canadian data from 2000 to early 2004 indicate that at least 23 types of freshwater fishes were imported for the live food fish markets; nine of which are not native to Canada and two with names not found in the literature. These fishes were imported from the United States, Vietnam and Hong Kong, and were either farmed or wild caught. Asian carps contributed the largest percentage of imports (by weight) of non-native live freshwater fishes for the food trade. This industry has been a vector for the introduction of invasive species by providing a source of live individuals that can be released into non-native waters through several pathways. These pathways of introduction include accidental release via trucking accidents and deliberate release for religious, ceremonial or ethical reasons. The Province of Ontario has passed legislation to prohibit possession of live Asian carps and two more provinces are currently in the process of passing legislation. The Canadian federal government has been involved with developing risk assessments for Asian carps and conducting research on the live food industry and its pathways of introduction.

Habitat Selection and Dispersal Rates of Bighead and Silver Carp in the Lower Illinois River

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To predict the potential spread of introduced exotic species, we must be able to quantify their dispersal and habitat use. Asian carp have become an increasing nuisance in recent years in the Illinois River, a tributary of the Mississippi River, potentially competing with native species. We implanted fifty silver carp and fifty bighead carp with ultrasonic transmitters during 2004 to quantify their habitat use and movement in the lower Illinois River (River kilometer, Rkm 129 to Rkm 0) in 2004 and 2005. Intensive, weekly mobile tracking during the spawning season and intermittent tracking during fall through winter quantified macro-habitat use. Movement between Rkm 115 to Rkm 3 was continuously monitored with stationary receivers (N=10). Available habitat was quantified to determine selection; both species demonstrated preference for channel border and island side channel habitat, but exhibited generalist qualities defined by the selection criteria. Movement in the spring was correlated with a rise and fall of river stage both years. Mean km/day for bighead carp and silver carp was quantified for both species (bighead carp 6.8 km/day, silver carp 10.6 km/day), demonstrating that these species have high dispersal capabilities. This ability is characteristic of a species that can propagate novel waters rapidly.

Dynamic of Fish Larvae Amount of the Four Famous Chinese Carps in the Middle Reach of the Yangtze River from 1997-2005

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The four famous Chinese carps, i.e. grass carp (*Ctenopharyngodon iddillus*), black carp (*Mylopharyngodon piceus*), silver carp (*Hypophthalmichthys molitrix*) and bighead carp (*Aristichthys nobilis*), cast their drifting eggs in the running water of the Yangtze River. In the years from 1997-2005, a systematic study on the dynamic of fish larvae amount of the four famous Chinese carps was carried out in the middle reach of the Yangtze River, close to the city of Jianli. It was calculated that in the breeding season from early May to late June the amount of fry drifting through the section of Jianli was 3587 million in 1997, 2747 million in 1998, 2154 million in 1999, 2854 million in 2000, 1904 million in 2001, 1900 million in 2002, 406 million in 2003, 339 million in 2004 and 105 million in 2005 respectively. Several environmental parameters related to the dynamic of fish larvae were also investigated simultaneously. Since the construction of the Three Gorges Dam near Yichang between the upper and middle reaches on the main stream of the Yangtze River, some influence on fish larvae have occurred.

Management and Regulation of Asian Carps in Arkansas: Status and Historical Perspectives

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Following importation of grass carp (1963) by the U.S. Fish and Wildlife Service (USFWS), state and federal agencies and private aquaculture have worked with Asian carps. With technical support from USFWS and Arkansas Game and Fish Commission (AGFC) and research by the Illinois Natural History Survey and Auburn University, a bighead carp foodfish industry emerged in Alabama, Arkansas, Mississippi, and Missouri. Extension has developed on-going programs relevant to prevent and control the spread of carps. New farmers are assisted in proper pond site selection, levee construction, and water control structures. Farm biosecurity programs target prevention of introductions and escapes of pathogens and ANS. Arkansas programs have a high success rate transferring knowledge into farm practice. AGFC regulates fisheries resources in Arkansas. The Approved Aquaculture Species List indicates which species may be imported and traded within the state, but does not allow release into public waters. The Restricted Species List requires a permit that specifies location and measures taken to eliminate escape possibilities. Permits require construction of barriers that prevent escape. Species not on either list are evaluated individually, with the burden of proof of escape prevention on the applicant. Arkansas has initiated development of a state ANS Plan.

The Australian Approach to Invasive Fish Species Research

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Australia has had a national research focus on invasive terrestrial species through its cooperative research centre system for more than 10 years. This has concentrated on familiar targets such as rabbits, mice and foxes.

Surveys of Australia's largest river system, the Murray Darling confirmed that invasive fish species, mainly common carp constituted in excess of 90% of the fish biomass at many sites, consequently the need for a coordinated focus on fish was also apparent. Carp and other invasive species are also a major problem in many other catchments around the country. As one part of a coordinated national approach, the Australian Federal Government, with major support from the Murray Darling Basin Commission, has now funded a Freshwater Products and Strategies Program within the Invasive Animals Cooperative Research Centre. This Program is a national and international partnership of natural resource management agencies, universities, industry and the community. The objective is to develop an integrated pest fish management strategy initially for the Murray Darling Basin but eventually for Australia as a whole.

Any pest management strategy requires a number of elements including a support framework involving early warning and response processes, education and community engagement as well as a legislative and policy base. It also requires control methods and species specific information.

The Freshwater Program has projects underway in a number of these areas but this presentation will concentrate on those projects that may be more broadly applicable to invasive fish species management in general. This includes platform technologies or control methodologies that could, either directly or indirectly, be applied to a range of fish species including genetic techniques such as 'daughterless', sensory attractants including pheromones, as well as biocides and disease evaluation. Some trapping and capture control projects are also relevant.

Species specific work is being undertaken with common carp and tilapia being the primary targets at this stage. The approach to the individual species involves a thorough assessment of life history and population dynamics with the objective of identifying any 'Achilles Heel' type opportunities that may be exploited for control purposes. Population models have been developed for carp to assist in evaluating control options and for tracking any population changes and this experience could be useful in a wider context.

Reproduction of Asian carp in Time and Space: Utility of a Source-sink Approach

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The Mississippi and Illinois River systems are a mosaic of habitats available for the establishment and persistence of Asian carps. Water levels of these reaches vary spatially (e.g., regulated versus unregulated) and temporally (e.g., flood versus drought). Given that conventional wisdom holds that sustained flow is necessary for successful reproduction of these fishes, patterns in flow as affected by regulation and climate should drive reproductive success and population growth. During the warm, high-water months of 2004 and contrasting drought of 2005, adult bighead and silver carp reproductive status and larval production were quantified in the Illinois River. During 2005, larvae and juveniles also were sampled in the pooled and open reaches of the upper Mississippi River (UMR). During the high water of 2004, Asian carp gonad weights were low but larval production was high. The converse occurred during the 2005 drought, with adult females reabsorbing eggs and larvae rarely occurring. In 2005, juvenile Asian carp only occurred in the open, flowing portion of the UMR. Adult reproduction, offspring production, and ultimately the establishment and spread of these species appear to depend on spatial and temporal patterns of flow. Combined drought plus impoundment during summer may curb reproduction.

Use of stable isotopes to compare the trophic status of bighead, silver carp, and filter-feeding fishes native to the United States.

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Bighead and silver carps are native to China and invasive in North America. Both species have been cultivated as food fishes in China for over a thousand years, but are new-comers to this country. Bighead and silver carps are considered to be plankton or suspended particle feeders with silver carp relying largely on phytoplankton and bighead on zooplankton. There is a high potential for competition for food resources with indigenous species depending on lower trophic levels in the water column. Traditional feeding analysis includes direct observation on animal feeding or gut content analysis. However, the relative abundance of food items in the gut does not necessarily reflect the importance of assimilated foods. Stable carbon and nitrogen isotope analysis provides a powerful tool to track the food sources supporting animal growth and the trophic positions of aquatic animals. This is because stable isotope compositions reveal the food assimilated by fish over time. Recent studies with the isotope approach indicate that silver carp and bighead are suspended feeders. In Chinese fish ponds and lakes, their diets are overlapped and both species largely depend on zooplankton as the source of their nutrition for growth. These results refute the classic view of herbivorous feeding mode by silver carp. Samples of silver carp, bighead, and local filter-feeding fishes including shad, paddlefish and bigmouth buffalo from the Missouri River, USA, are being analyzed for stable isotope ratios. Information from this study will be helpful to understand if the carps are competing for natural food resources with indigenous species.

Management Implications from a Stock-recruit Model for Bighead Carp in Portions of the Illinois and Mississippi Rivers

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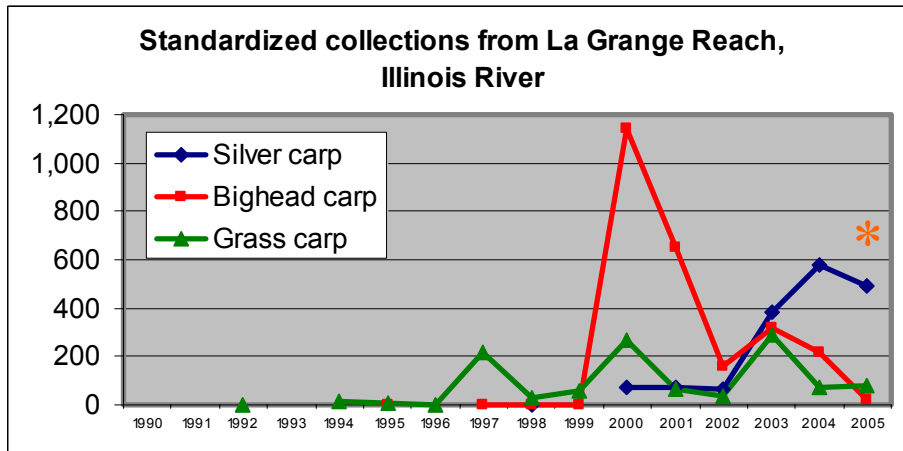
The bighead carp (*Hypophthalmichthys nobilis*) was imported into the southern U.S. from Asia, and then escaped into the Mississippi River Basin where self-sustaining populations are established. As part of the Long Term Resource Monitoring Program, we studied the population dynamics of bighead carp in the LaGrange Reach of the Illinois River and Pool 26 of the Mississippi River during 2001-2004, and then developed a Ricker stock-recruit model from the population data. The validated model explained 83% of the recruitment (in July of the first year of life) variation using stock size and the coefficient of variation in river discharge during July. Seventy-two percent of the total variation is explained by stock size variability, while 11% is explained by variability in river discharge. Model predictions and empirical data indicated that management efforts to reduce stock size from the optimum of 0.07 adults/unit of standardized fishing effort to 0.02 adults/unit of effort should be the most effective tool to reduce recruitment to low levels. This level of adult abundance should be the target maximum for bighead carp stock control efforts in the study areas. Because recruitment was inversely correlated with the variation in river discharge in July, it may be theoretically possible to integrate control of stock size (by harvest) and management of river discharge at dams (increase variation of water discharge) in the Illinois and Mississippi rivers to maintain recruitment at levels low enough to minimize abundance and ecological and economic impacts of adults.

Value of Asian Carp Data Collection by the Long Term Resource Monitoring Program to Large Rivers of the U.S.

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Non-native Asian carp (bighead carp *Hypophthalmichthys nobilis*, silver carp *Hypophthalmichthys molitrix*, and grass carp *Ctenopharyngodon idella*) have been present in the Illinois River since the early 1990's. The Long Term Resource Monitoring Program (LTRMP) is part of an Environmental Management Program on the Upper Mississippi River System (UMRS) that has monitored fish communities since 1990. This program has enabled researchers to gather information since early in the invasion by Asian carp of the UMRS. Bighead carp have been collected by the LTRMP through routine monitoring of the La Grange Reach, Illinois River since 1995, silver carp since 1998, and grass carp as early as 1992. The LTRMP fish data reveals significant spawn and recruitment of both bighead and silver carp in 2000, and variable spawning success since. Length distributions from this data give insight into growth rates and cohort strength. Additionally, bighead and silver carp dietary overlap with two species, gizzard shad *Dorosoma cepedianum* and bigmouth buffalo *Ictiobus cyprinellus*, is suspected. The long-term monitoring also gives a unique perspective into the invasion of these species, and gives initial insights into possible ecological impacts within a fairly large basin. Data may also suggest future implications as these non-native fish expand their range.



*LTRMP only sampled 2 of 3 time periods

Alternative Methods of Snail Control

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The black carp <i>Mylopharyngodon piceus</i> has been used in the United States for over two decades to control snail populations in aquaculture ponds. Recent use of diploid black carp has raised serious concern over introductions of this exotic species into natural water bodies. Consequently, researchers have been investigating other methods of snail control including native species, chemical and pond management techniques. Although several studies have been conducted, no one method appears to be the useful in all situations. An overview of the ability of redear sunfish, freshwater drum, blue catfish and various hybrid sunfish to control snails and the various pros and cons of each species will be provided. Additionally, the effectiveness of chemicals and various management techniques to reduce snail populations will be discussed. Finally, recommendations for further research will be suggested.

Introduction and Status of the Grass Carp in Fresh waters of Pakistan

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Biological invasion by Invasive Alien Species (IAS) is now recognized as one of the major threats to native species and ecosystems, yet awareness of the problem is alarmingly low. The effects of IAS on biodiversity are immense and often irreversible. One of the most frightening aspects of globalization is the movement of exotic plants and animals into virtually every ecosystem on earth. *Ctenopharyngodon idella*. Grass carp has been introduced into Pakistan in 1975-76 from Singapore by the Karachi Municipal Corporation. At first instance it was kept in the cemented and earthen ponds inside the building of Karachi municipality office and then it was introduced in Halegee Lake in year 1976. Later on grass carp was imported by Punjab Fisheries Department in 1976 from Bangkok and was successfully induced to breed at the public sector hatcheries of Punjab and gave very good results regarding fecundity, fertilization, hatching, acclimatization, survival, growth, and feeding. Later on Punjab Fisheries Department introduced grass carp deliberately in rivers and lakes of Punjab during annual stock replenishment program in order to control the excessive vegetation of lakes and rivers of Pakistan. Now a day Grass Carp is a preferred fish of fish farming community because of its growth and high yield in the polyculture along with native carps *Labeo rohita*, *Cirrhinus mrigala*, *Catla Catla*, and exotic *Hypophthalmichthys molitrix* and *Aristichthys nobalis*. There s an indication in the present study that grass carp has got a major alien fish specie status in a relatively short period after its introduction in natural water bodies after *Cyprinus carpio* in Pakistan.

Environmental Effects of Black, Bighead, Grass, and Silver Carps in Areas Outside of Their Native Ranges

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Asian carps, particularly bighead, grass, and silver carps, have been widely introduced outside of their native ranges for beneficial uses such as water quality improvement, removal of aquatic plants, or to improve fishery production. Escaped or released Asian carps from aquaculture facilities have also become established in several countries. Whether released intentionally or unintentionally, the establishment of Asian carps often leads to measurable changes in the invaded ecosystem. Although some of the changes have been intended, such as the reduction of aquatic plants or clearing of plankton blooms, other unintended and detrimental changes affecting flora and fauna native to the ecosystem have sometimes occurred. Documenting negative environmental effects of Asian carps around the world is complicated by the fact that these species were often purposefully introduced and little thought was given to potential negative environmental effects. Therefore, monitoring of environmental variables after Asian carp introduction was rarely conducted. Clear patterns are, however, beginning to emerge in the literature. Documented environmental effects of Asian carps from areas into which they have been introduced will be presented. On the basis of these historical effects, the potential effects of black, bighead, and silver carps in aquatic ecosystems of the United States will be discussed.

Characterization and development of pheromones to control invasive bighead and silver carp.

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Species specific chemical signals, pheromones, maybe useful in attracting or repelling invasive carp and in this manner may be effective in controlling them. Our research has confirmed the presence of alarm substance in skin extracts of big head and silver carp. This alarm pheromone is released when the skin is injured as during an attack by a predator. Controlled laboratory studies with aqueous skin extracts indicate that bighead carp form tight schools in the presence of the extract, whereas explosive random movements are often induced in silver carp. Avoidance chamber studies demonstrate that both species strongly avoid areas where the extract is released. Extracts that have been aged for 24 hours or that have been frozen retain their effectiveness in inducing significant avoidance reactions. In preliminary studies adult fish also appear to avoid pond areas that have been treated with skin extract solutions. Studies are presently underway to determine the existence of an aggregating pheromone that could be used as an attractive lure.

History and Status of the Chicago Sanitary and Ship Canal Dispersal Barrier

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The National Invasive Species Act of 1996 authorized the U.S. Army Corps of Engineers to carry out a demonstration study to prevent the spread of invasive species through the Chicago Sanitary and Ship Canal. This century-old man-made canal forms a two-way link between the Great Lakes and Mississippi River drainages. During the ten year life span of this project the species of primary concern began with the Eurasian Ruffe, then moved to the Round Goby and most recently interest has shifted to Bighead and Silver Carps. A demonstration barrier completed in 2002 has nearly reached the end of its service life. A larger, more permanent and effective barrier is partially constructed and will begin operation by the end of 2006. Biological monitoring of the demonstration barrier, which will be discussed in a separate paper, has shown that only one tagged fish passed through the demonstration barrier array. Prior to achieving full operation, the new barrier design must overcome concerns regarding safety of people in the water and the effect of the electric field on commercial barge operation in the canal. This paper will discuss the development of the barrier, current hurdles and possible future directions for barrier operation and development.

The Black Carp in North America: An update

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The Black Carp *Mylopharyngodon piceus* is one of several large cyprinids from eastern Asia introduced into North America. Commercial fishers informed us that they have been netting Black Carp in the lower Mississippi River basin since the early 1990s, although it was not until 2003 that specimens were seen by scientists. Earlier captures went unreported as fishermen mistakenly believed the fish were simply an unusually dark-colored "Grass Carp". Reproductive requirements of Black Carp are similar to the three other Chinese carps already established in North America. There is evidence that Black Carp are also established: (1) presence in the wild over 10 years; (2) existence of suitable conditions to support their entire life cycle; and (3) captures include diploid adults. Although no national program to monitor captures exists, we have developed contacts with certain commercial fishers and arranged to obtain any Black Carp specimens collected. Specimens are important, particularly for documenting distribution, providing information on size and reproduction, and data on diets. Because Black Carp grow to over one meter long and prey heavily on mollusks, diet studies are critical in determining which mussels are being consumed and if Black Carp gape size is a reliable predictor of prey vulnerability.

Reproductive Condition and Occurrence of Intersex in Bighead Carp and Silver Carp in the Missouri River

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Little is known about the reproductive biology of the exotic bighead carp *Hypophthalmichthys nobilis* and silver carp *Hypophthalmichthys molitrix* in the Missouri River. In order to fill this gap in understanding, herein is described the reproductive condition of these Asian carps. Evidence is presented which indicates that bighead and silver carp in the Missouri River have a protracted spawning period that extends from early spring through fall and some individual bighead and silver carp are spawning multiple times during a reproductive season. Although bighead and silver carps are successfully maturing and spawning in the Missouri River some reproductive abnormalities such as intersex, atresia, and sterility were observed. Knowledge of the reproductive activity of these invasive carps may be useful to resource managers tasked with their control. Furthermore, the reproductive abnormalities observed should be considered when evaluating the environmental condition of the Missouri River relative to supporting a healthy fish fauna.

Reproductive potential and verification of ploidy in triploid black carp (*Mylopharyngodon piceus*) and grass carp (*Ctenopharyngodon idella*).

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Triploid grass carp and black carp are produced and used throughout the Mississippi River basin to control unwanted aquatic vegetation and as a solution to parasitic trematode problems in the aquaculture industry, respectively. Some genetics research suggests that triploids of these species are not necessarily sterile and may produce viable gametes and offspring. Therefore, our objectives were to: 1) compare the accuracy of methods used to verify triploidy; 2) evaluate the reproductive potential of triploid and diploid black and grass carps; and 3) determine population characteristics (growth and survival rates) of black carp. Flow cytometry identified 2 diploid black carp in 1000 presumed triploid fish as tested by the Coulter Counter® method. Necropsy and histology revealed that both triploid and diploid grass carp males produced sperm. Triploid grass carp ovaries predominately contained oocytes arrested at early stages of development; however, maturing oocytes were identified scattered throughout the organ. Collectively, these data suggest a potential for black carp to establish populations in the Mississippi River Basin.

Establishing Biosecurity Barriers to Prevent Unintentional Spread of Asian carp

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Aquatic invasive species, diseases and parasites move from place to place as undetected, non-target hitchhikers in shipments of fish. Agency stockings and private baitfish distributions from infested to non-infested waters are potential pathways to spread Asian carp. Developing biosecurity barriers could prevent further expansion through these pathways. Pillsbury Foods developed the HACCP system in the 1960's to ensure food safety produced for the space program. It is now the world gold standard used in food production because it works! Hazard Analysis and Critical Control Point (HACCP) is a straightforward planning tool. Its logic has been modified slightly for pathway management so that best management practices (BMPs) are strategically identified at pivotal pathway locations to prevent or remove hitchhiker risks. The efficiency of pathway barriers is improved through regular plan review and modification. Strategically examining linked complexes of actions focuses preventions at critical control points (CCP) in the pathway developing multiple biosecurity barriers.

Human mediated introductions are not accidental, just unplanned! Coordinating plans between both ends of the pathway increases biosecurity. This presentation describes how to develop biosecurity for facilities and watersheds by applying a HACCP strategy for aquatic shipment pathways. Planning support is available at www.HACCP-NRM.org

Toxicity of Rotenone and Antimycin to Silver and Bighead Carps

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The general public, natural resource managers, as well as other governmental agencies have become increasingly concerned about the continued spread of bighead (*Hypophthalmichthys nobilis*) and silver (*H. molitrix*) carps in the Mississippi River Basin and their potential spread to the Great Lakes. An integrated approach of chemical, biological, and physical measures are needed to reduce Asian carps in these waters. Rotenone and antimycin are the best candidate chemicals for use in the control of Asian carps. There is considerable information regarding the toxicity of these compounds to numerous fish species, however, little toxicity information is available for controlling Asian carps. The purpose of this study was to determine the 24 and 96 hour post-exposure toxicity of rotenone and antimycin to silver and bighead carp exposed to the chemicals for 2, 4, 8, 12, or 24 hours (contact times). Each static exposure was tested in triplicate at 12, 20 and 27 °C. Tests were conducted according to procedures prescribed by ASTM and the Committee on Methods for Toxicity Tests with Aquatic Organisms. Rotenone and antimycin were more toxic as the water temperatures increased. Both compounds would be toxic to Asian carps within label guidelines.

Regulations as a Tool in Asian Carp Management

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Regulations are one of the few tools available in the aquatic nuisance species management toolbox. In a perfect world, regulations could be used to effectively prevent invasive species from entering the country from foreign lands. But federal regulations are weak and used reluctantly because they are heavily influenced by regional and national political and economic considerations. State regulations, on the other hand, are less influenced by these considerations, but often suffer from the influence of their own local issues. Some states maintain strict policies and regulations with regard to Asian carp possession and use, but a neighboring state may not, and all states are connected by a vast network of rivers, waterways and streams, so invasions continue to occur. Consequently, Asian carp management in the U.S. is largely controlled by the "least common denominator" regulation that applies in a given watershed and beyond. This paper presents an overview of Asian carp regulations in the 50 U.S. states and offers a plea for standardization at a higher common denominator.

To Catch a Carp

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This presentation will give an overview of activities taken by the State of Illinois to prevent introduction and further spread of Asian carps in the State. The ecological and economic threat that Asian carps present to the State of Illinois will be discussed through impacts to commercial fishing, recreational water use, native populations, and market analysis. A survey of activities for countering these threats will include a summary of legislative initiatives, policies, and administrative rules adopted by the Illinois Department of Natural Resources (IDNR). Efforts by IDNR and its regional partners for development of a barrier system to prevent Asian carp introduction into the Great Lakes also will be presented. Asian carp products and business strategies are being promoted to encourage population reduction through increased harvest. Finally, there will be a discussion of modified behaviors as a result of policy change: what has been effective, and what has not.

Integrated and Pheromonal Control of Common Carp

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The common carp, *Cyprinus carpio*, was introduced to North America over 100 years ago and quickly established itself in our shallow lakes, wetlands, and rivers where it continues to wreck great damage. Although numerous techniques have been employed to control this species (poisons, water draw-downs, barriers, fishing-out), none have achieved notable success. However, to date, none of these have been guided by any particular conceptual framework and management goals have been vague. Yet, the common carp is a relatively well understood species of fish and many of the systems it plagues are small and/or closed - opportunity for its control appear greater than for other carps for which it might be viewed as a model. We are studying the population dynamics and reproductive biology of common carp with the intent of developing an integrated pest management program to exploit weaknesses in its life history. Initial results are encouraging. We find that its spawning habits are both restricted to specific regions and times and that recruitment bottlenecks likely exist. Behavioral studies also describe pheromonal attractants that might be used in trapping. Studies of population structure are also starting but will be outlined. (Legislative Commission for Minnesota Resources, Invasive Animals Cooperative Research Centre, Minnesota D.N.R.).

Field Assessment of the Electric Dispersal Barrier in the Chicago Sanitary and Ship Canal

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Since the first electric barrier in the Chicago Sanitary and Ship Canal was activated in April 2002, we have released 130 tagged common carp downstream of the barrier to assess the ability of the barrier to prevent upstream passage of fish. Fixed hydrophones and radio antennas continuously monitor the Canal in the vicinity of the Barrier for the acoustic and radio signals from the transmitters. In addition, periodic surveys are conducted with boat-mounted receivers, to locate transmitters that are out of range of the fixed receivers. Only one tagged fish has passed through the barrier (in April 2003). It passed at the same time as a barge, which may have facilitated the passage of the fish, either by entraining the fish or by distorting the electric field. After we reported the passage, Smith-Root, Inc. increased the strength of the electric field by 50%. Since then, we have not detected any further passages of tagged fish. A more stringent test is planned for 2006. The test requires simultaneous operation of the old barrier with a new, more advanced barrier, and will assess the ability of the barriers to retain tagged fish that are released between them, in a confinement zone.

Asian Carp in Louisiana

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In the 1970s, freshwater fishermen reported seeing grass carp *Ctenopharyngodon idella* in Louisiana's large rivers and backwaters; the first specimen in Louisiana Department of Wildlife and Fisheries' fishery-independent sampling was taken in 1976. Commercial fishermen began to report ever-increasing populations of bighead *Hypophthalmichthys nobilis* and silver carp *H. molitrix* beginning in the early 1980s. In 2002, harvester reports of sporadic capture of "different-looking" grass carp resulted in the collection of several black carp *Mylopharyngodon piceus*. Since then, six black carp have been collected from Louisiana rivers, and postmortem ploidy determination using cells from eyeballs of each of the tested fish showed them to be normal diploids. Reported commercial landings of grass, silver, and bighead carp are now about 80,000 lbs/yr, but limited demand for bighead and silver carp results in many captures being discarded. Improved market value could occur through expanded local use as crab and crawfish bait. A simple machine for cutting large carp into bait-sized pieces has been developed. Increased value would improve profitability in river and crab fisheries and in crawfish fishing and farming and could reduce the standing stock of these invasive species.